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RADIO-TELEGRAPHY.—*Damped and undamped oscillations.*

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The idea has occurred to me that the ground absorption of damped and undamped oscillations might differ from each other, other conditions being the same. Therefore the following experiment was carried out between the Naval Academy at Annapolis, Md., and the Radiotelegraphic Laboratory at Washington. The antenna at Annapolis is of the harp form, approximately 150 feet high. In this damped oscillations were produced by a Fessenden rotary gap 2 kw. sending set of the type used in our long distance quantitative measurements.[1] The continuous oscillations were produced by a Poulsen arc. In both cases the resonance curve of the antenna was examined by means of a wave meter to make certain that only one definite wave length was emitted The coupling of the Fessenden set was made extremely loose so as to reduce the antenna current to the value obtainable from the arc, the decrement being approximate y 0.15. This antenna current was 3.5 amperes and the wave length with each set was 1060 meters.

The antenna at the Radiotelegraphic Laboratory is an eight wire harp approximately 180 feet high at top and 60 feet high at bottom. This makes the center of capacity 120 feet above the earth. Taking the height of the center of capacity of the Annapolis antenna as 75 feet from the earth, from the data

[1] Bulletin Bureau of Standards, 7:315. 1911.

given in Table XVI of the paper already cited it is possible to calculate the amount of energy which would have been received at the given distance (30 miles) over salt water. The current reduced to a receiving antenna resistance of 25 ohms would amount to $210 \cdot 10^{-6}$ amperes. The actual current received was $76 \cdot 10^{-6}$ amperes, therefore, the ground absorption amounts to 64 per cent.

The currents were measured as in the former experiments[2] by means of a rectifying detector with galvanometer in a circuit coupled to the antenna. The galvanometer deflections amounted on an average to 80 millimeters and no certain difference could be detected between the deflections due to the damped and to the undamped oscillations. The uncertainty of the observations amounted to probably 10 per cent. No correction was made for the difference in effective resistance of the receiving antenna for the damped and undamped waves. This might amount to from 10 to 20 per cent.

The conclusion to be drawn is that the absorption of the energy of the waves in passing over the country in question was the same in the case of the undamped and moderately damped oscillations within the limits of the errors of observation.

RADIO-TELEGRAPHY.—*Suitable wire sizes for high frequency resistance.* L. W. AUSTIN, U. S. Naval Wireless Telegraphic Laboratory.

It often becomes necessary in high frequency testing to introduce definite amounts of resistance into the circuits. For the sake of convenience in calculation it is usually desirable to have the wires composing the resistances of such size as to make the so-called skin effect negligible since in this way it is possible to measure the resistance by direct current methods and to be sure that the high frequency resistance will be practically the same in value. If the experimenter does not take the trouble to calculate the relation between high frequency and direct current resistance, he is frequently led to use resistance wires of too small size, thus unnecessarily sacrificing current carrying capacity.

[2] Bulletin Bureau of Standards, 7:295. 1911.

I have, therefore, from data given by Professor Zenneck[1] graphically computed the sizes of wire which may be used at various wave lengths without causing the difference in direct and high frequency resistance to exceed 1 per cent. Doubling the diameter given in the table will produce a difference between direct and high frequency resistance of approximately 10 per cent, while one-half the diameter given in the table will reduce the difference to approximately $\frac{1}{10}$ per cent, (Zenneck). The values are given for copper and platinum as well as the high resistance materials constantan and manganin. Advance wire is practically identical electrically with constantan, while for high resistance German silver the values are nearly the same as for manganin.

TABLE OF WIRE SIZES

FOR WHICH THE HIGH FREQUENCY RESISTANCE WILL BE LESS THAN 1 PER CENT GREATER THAN DIRECT CURRENT RESISTANCE

WAVE LENGTH	CONSTANTAN OR ADVANCE WIRE		MANGANIN DIAMETER	PLATINUM DIAMETER	COPPER DIAMETER
	Diameter	Maximum Current			
m.	mm.	amp.	mm.	mm.	mm.
100	0.30	3.5	0.29	0.13	0.006
200	0.46	4.5	0.40	0.20	0.045
300	0.57	5.5	0.50	0.27	0.09
400	0.66	7.0	0.60	0.30	0.10
600	0.83	8.0	0.75	0.37	0.15
800	0.98	10.0	0.88	0.42	0.20
1000	1.10	11.5	0.99	0.50	0.21
1200	1.20	12.5	1.10	0.57	0.22
1500	1.30	14.0	1.21	0.63	0.26
2000	1.52	17.0	1.38	0.73	0.30
3000	1.80	24.0	1.62	0.80	0.33

The column of the table under Maximum Current gives the approximate current which may be carried by the various sizes of constantan wire without undue heating. The current capacity of the manganin is very nearly the same.

[1] Zenneck, Leitfaden der drahtlosen Telegraphie, p. 352.

Of course carbon and various electrolytes may be used instead of the metals, with even smaller corrections but the temperature resistance coefficients of these are so large that they are generally less suitable for use as resistances than constantan or manganin.

When a greater current carrying capacity is desired the wires may be frequently used in parallel soldered between parallel metal strips, provided the spacing is not too small.

ANALYTICAL CHEMISTRY.—*The accurate volumetric determination of phosphoric acid in phosphate rock.* JOHN G. FAIRCHILD. Communicated by F. W. Clarke. To appear in the Journal of Industrial and Engineering Chemistry.

The method here proposed is a modification of Pemberton's caustic alkali titration. In its original form Pemberton's method gives results 1.5 per cent low in comparison with the standard method of weighing the phosphoric acid as magnesium pyrophosphate. This error is reduced to zero by precipitation of the soluble phosphate with barium chloride in excess. The greatest error resulting in the analysis of eight phosphate rocks by this method was 0.32 per cent of P_2O_5, parallel determinations being made by the gravimetric method. The average error was 0.03 per cent of P_2O_5. The accuracy is 99 per cent as compared with an accuracy of 99.5 per cent for the gravimetric method. The advantage of the volumetric method is its rapidity, not more than one hour being required for a complete determination. Attention is called to the fact that the barium phosphate precipitated undergoes hydrolysis, necessitating moderate sized portions for titration. Also, that without this modification the apparent percentage of phosphoric acid is less, the larger the portions titrated.

GEOLOGY.—*Age of the Worcester phyllite.* DAVID WHITE.

The Worcester phyllite consists largely of altered clay shales, some of which are very highly carbonaceous, but comprises also thin beds of sandy shale and sandstone. The rock, which has generally been termed an argillite, is, under the name phyllite,

clearly described in great detail, by Perry and Emerson in the "Geology of Worcester, Massachusetts,"[1] and is mapped as occupying two synclines lying with a northeast trend beneath the city of Worcester. The formation in the eastern syncline is best exposed by the Boston and Albany Railway cut, between the Union Station and Lake Quinsigamond. Another outcrop, classic in the literature, occurs at the "Old coal mine" northwest of Wigwam Hill, in the grounds of the Normal College of the Sisters of Notre Dame. Several times during the last century attempts have been made at this old "mine" to work a thin bed of graphitized impure coal. Here the strata, which dip steeply to the north-northwest appear to be less altered than in most places, and the bedding is fairly distinct.[2] The minerals resulting from the metamorphism are fully described by Perry and Emerson. Dark, slaty phyllite and schist, richly carbonaceous, accompany the graphitic bed. A lower stratum still retains certain features which to the writer strongly suggest the so-called fire-clay beneath a coal bed. Veins of quartz or other minerals are inconspicuous at this locality, though the results of deformation are obvious in the slicken-sided layers. The more graphitic portions of the section now consist largely of thin, curly, slicken-sided, carbonaceous scales.

The phyllite rests on a quartzite described by the above-named geologists as the Worcester quartzite. The agreement of the quartzite with the phyllite in structure, probable conformity, and comparable alteration, is made a basis for regarding both as probably belonging to the same period. Both the phyllite and the quartzite are reported to be less altered at Worcester than elsewhere. Away from this point the phyllite is said to change to a mica schist, and the quartzite to a mica quartzite, which, according to Perry and Emerson, becomes their Paxton schist o[illegible]e west, in the plateau of central Massachusetts, and th[illegible]olton

[1] "The Geology of Worcester, Massachusetts," by Jos. H. Perry and Benj. K. Emerson. Worcester, 1903, pp. xii and 166, with map and numerous plates.

[2] The outcrop is photographically shown opposite p. 12 of the work just cited. The term "phyllite" is employed in conformity with the usage of Merrill (Rept. U. S. Nat. Mus., 1890, p. 390).

gneiss, on the east, the sediments having been more argillaceous westward, and more arenaceous eastward. The Brimfield schist, described by Emerson and Perry as overlying their Paxton schist, is accordingly correlated by them as a more highly metamorphosed phase of the Worcester phyllite.

Tho these beds were described more than three-quarters of a century ago and have been visited by scores of geologists, the widest views have prevailed regarding their age. As often happens in graphitic argillites, mineral or cleavage forms accidentally resembling graphitized remains of plant fragments are plentiful. Some of these closely imitate imperfect fragments of Cordaites, Calamites, Lepidodendron, etc. In 1883 a specimen was found by Professor Perry which appeared to be a true fossil, consisting of a fragment of a Lepidodendron stem impression, in which the somewhat indistinct leaf cushions were still comparatively regular in their quincunxial arrangement. This specimen was submitted by Perry to Leo Lesquereux,[3] who regarded it as probably belonging to *Lepidodendron acuminatum*, a Carboniferous species. On the evidence of the relatively minor degree of alteration, the occurrence of the graphitic bed, and this unfortunately rather obscure fossil,[4] Perry and Emerson have courageously insisted on the Carboniferous age of the phyllite, notwithstanding the scepticism of most geologists and paleontologists, some of whom, denying the validity of the fossil, have continued to regard the beds as not younger than Algonkian. Spurred by criticism, Professor Perry continued the search, with the result that after sixteen years the counterpart or reverse of the same stem fragment impression was discovered. This side, however, was scarcely more distinct than the other, and accordingly added nothing to the evidence as to the age of the phyllite.

Since it was evident that in the midst of soft clay shales, after such squeezing and alteration as at Worcester, there could be

[3] Am. Jour. Sci., Vol. XXIX, 1885, p. 157. See frontispiece "Geology of Worcester, Mass.," 1903.

[4] Another specimen, never reported on by a paleontologist, is said to have been sent to Columbia University.

little chance for the recognizable preservation of the delicate types of land plants most useful for age determination, the writer on the occasion of his brief visit to the old "mine" in October, 1911, set about the search for either clay ironstones or pyritic nodules ("niggerheads") which when occurring in the shales above coal beds are so often found to contain vestiges of more or less decayed but undeformed organic structures. The expectation that such sulphide nodules when surrounded by soft, plastic, and therefore compensating material, might, if present, have escaped serious deformation, was essentially borne out by the discovery of concretions containing recognizable fossils in the graphitic argillite. However, contrary to expectation, the concretions were found to contain brecciated shale fragments of various sizes and in varying attitudes. It appears that this shale was fractured or brecciated prior to the segregation of the sulphide. At present the interstices between the shale pieces, some of which were found to be as large as the palm of the hand, are largely occupied by asbestiform prochlorite (after fibrous pyrite?), though more or less iron sulphide is present.

The concretions above the graphite bed in the phyllite are few and rather hard to extract, and the included plant fragments in the particular shale layers represented therein appear to be scarce and generally small, but fortunately they are fairly distinct and practically undisturbed, the pieces of shale being less deformed so that the paleobotanical details are clear. In the relatively few fragments found during the writer's brief search, small portions of Cordaites leaves, probably *C. borassifolius*, are relatively plentiful. Other fragments include a small leaflet of Sphenopteris comparable to *S. dicksonioides* Stur; an isolated leaf cushion of Lepidodendron, possibly *L. obovatum;* a Sporocystis, and a small Equisetalean cone.

Thru the courtesy of Professor Perry the opportunity has been given the writer to examine and photograph one side of the Lepidodendron found by him in gritty schist. As to the validity of this impression there is no room for doubt. Though the bolsters are partially defaced and alteration products largely mask

the surface, there may be seen at several points imperfect outlines of what are, presumably, deformed leaf scars instead of mere pseudo-fossils. The trunk, which was perhaps a foot in diameter, may have belonged to *Lepidodendron Veltheimii*, or possibly *L. obovatum*.

Description of the fossils is deferred in the expectation that new efforts will bring to light additional material in the protected brecciated shale fragments. The specimens at present in hand, tho few and very fragmentary, are such as to put beyond question the Carboniferous age of the phyllite at Worcester, thus confirming the opinion of Professors Perry and Emerson. Judging by the details of the few pieces collected, the writer suspects that further discoveries will show the beds to be of Pennsylvanian, possibly Pottsville, age.

BOTANY.—*Annona diversifolia, a custard-apple of the Aztecs.* W. E. SAFFORD, Bureau of Plant Industry.

While engaged in the study of Annonaceae the writer found a specimen of Annona, or custard-apple, in the U. S. National Herbarium, remarkable on account of certain large, orbicular, leaf-like bracts at the base of the flowering branches, from which appear the peduncles, or flower stems, a peculiarity found in no other Annona thus far known, except *A. macroprophyllata* Donnell Smith. It proved to be an undescribed species, and a short description of it was published in *Science*,[1] under the name *Anona diversifolia*. The type material included bark, leaves, flowers, and immature fruit, (fig. 1) and the collector's field notes stated that the fruit, locally known as *ilama* or *izlama*, was reported to be edible. No description of the mature fruit was given, however, and it remained to be proved whether or not it could be identified with the celebrated *illamatzapotl*, or "zapote de las viejas," of the ancient Mexicans, the specific identity of which had never been established.

This fruit was first mentioned by Francisco Hernandez, the "protomedico" of Philip II, who was sent in 1570 to study the

[1] New ser., **23**: 471. March 24, 1911.

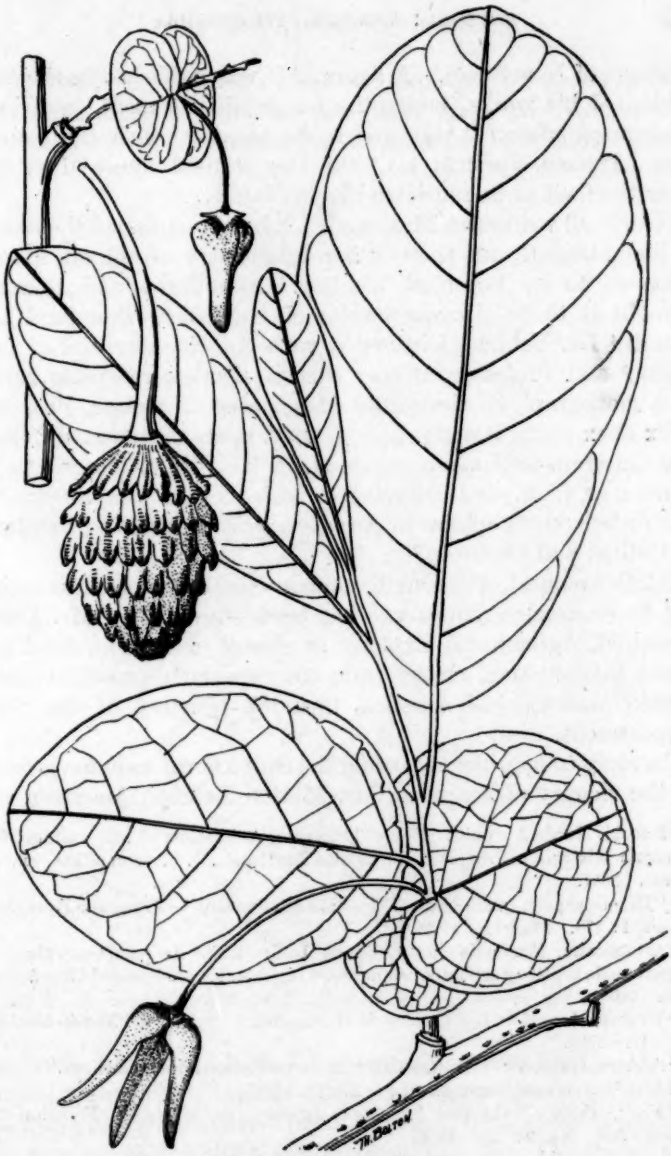

Fig. 1. *Annona diversifolia* Safford, natural size

products of New Spain. A figure of it was published in the first edition of his works, under the name *yllamatzapotli*,[2] and in a subsequent edition it was said to be identical with the *guanábano* (*Annona muricata* L.),[3] tho the original figure does not show the fruit to be muricate like the latter.

Nearly all writers on Mexican fruits have mentioned the ilama, or illamatzapotl, but there is a wide diversity of opinion among them as to its botanical identity. Altamirano and Ramirez thought it to be *Annona excelsa* of Humboldt, Bonpland and Kunth;[4] Dr. Urbina identified it with *Annona muricata* of Linnaeus;[5] and Professor Alcocer calls it *Annona reticulata* Linn.[6] In a monograph on the edible Annonaceae of Mexico, Professor Felix Foex, citing Ramirez as authority, refers the ilama of Colima and Guerrero to *Annona excelsa* H. B. K., without describing its flowers or fruit, and referring to its leaves as "*acuminadas*," a description which applies to *Annona excelsa* but not to the ilama of Colima and Guerrero.[7]

At the request of the writer much valuable information relating to economic Annonaceae has been obtained by Mr. David Fairchild, Agricultural Explorer in charge of Foreign Seed and Plant Introduction, chiefly from our consular representatives in Mexico and Central America, thru the courtesy of the State Department.

In reply to inquiries regarding the fruit known as ilama growing in the vicinity of Acapulco, Mr. Marion Letcher, American con-

[2] Recchi, Nardo Antonio: Nova Plantarum, Animalium et Mineralium Mexicanorum Historia a Francisco Hernandez Medico. . . . compilata. p. 444. Rome. 1651.

[3] "Illamatzapotl, quam Haitini Guanabanum vocant"—Francisco Hernandez. Opera, 1: 178. Madrid. 1790.

[4] Altamirano, Fernando and Ramirez, José: "Lista de nombres vulgares y botanicos de árboles y arbustos propios para repoblar los bosques de la República." p. 3. 1894.

[5] Urbina, Manuel: "Los zapotes de Hernandez." Anales del Muséo Nacional, 7: 212. 1902.

[6] Alcocer, Gabriel V.: "Catálogo de los frutos comestibles mexicanos." Anales del Muséo Nacional, segunda época, 2: 419. 1905.

[7] Foex, Feliz: "Algunas Anonáceas frutales de Mexico." Estacion Agr. Centr. Bol., No. 9: 25. 1908.

sul at that port, forwarded seeds and photographs, which showed it to be an Annona somewhat resembling the chirimoya (*Annona cherimola*) and sugar-apple (*Annona squamosa*) but quite distinct

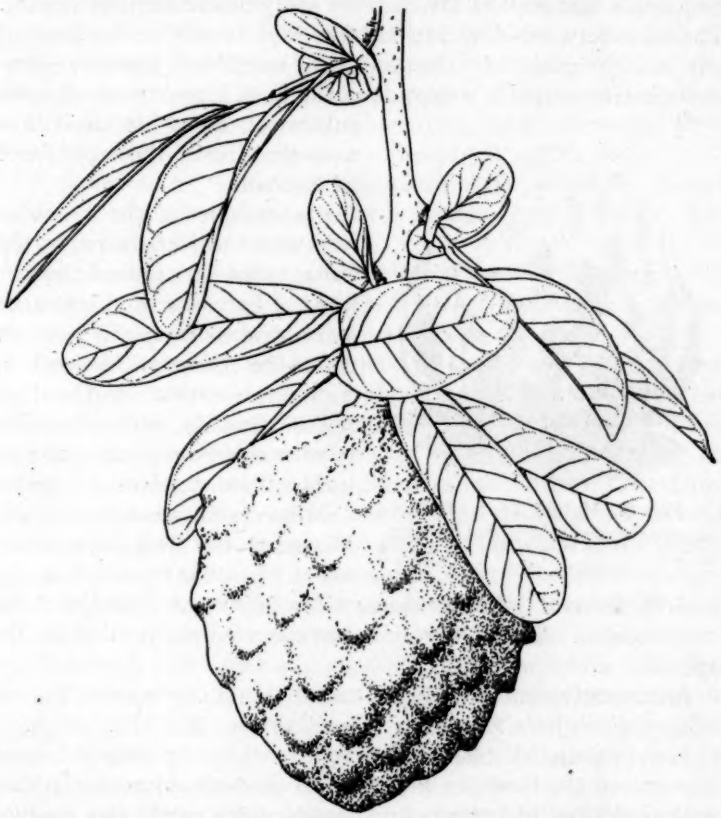

Fig. 2. *Annona diversifolia* Safford, showing fruit leaves and bracts, one-half natural size.

specifically from them both. Photographs, taken by Dr. H. K. Pangborn about two leagues back from the coast, show a tree with dense glossy foliage and pendant conoid fruit which appeared to be covered with whitish felt or cotton (fig. 2). The leaves are

distinctly rounded at the apex, very different in shape from the leaves of the other species mentioned, and the photograph of fruits, fully ripe and bursting open, show them to be shaped "like pine apple cheeses," as Mr. Letcher aptly describes them (fig. 3). The seeds forwarded by Mr. Letcher were totally unlike those of any known species of Annona. They resembled, however, some seeds in the economic collection of the U. S. Department of Agriculture of an unidentified Annona growing in the republic of El Salvador.

Fig. 3. Mature fruit of Ilama (*Annona diversifolia*) one-third natural size.

Photographs of the Acapulco fruit were accordingly sent by the writer to the Agricultural Department of Salvador, and a prompt and courteous reply was received from the Director General of Agriculture of that republic, Don Rafael Castillo, who identified it with the species called in Salvador "anona blanca." Señor Castillo also forwarded seeds and leaves of the "anona blanca," which identified it unmistakably with the ilama of Colima (*Annona diversifolia*) and with the ilama of Acapulco. The following is an amended description of the species.

Annona diversifolia Safford. ILAMA, or ILLAMATZAPOTL Fig. 1. *Anona diversifolia* Safford. Science, n. ser., **23**: 471. 1911.

Leaves petioled, blades varying from broadly elliptical, near the base of the flowering branches, to obovate-oblong and oblanceolate, higher up, rounded or obtuse at the apex, and rounded or acute at the base, membranaceous, glabrous, feather-veined, punctulate with minute dots; peduncles solitary 1-flowered, long and slender, recurved or pendent, issuing from one or two suborbicular, amplexicaul, glabrous, leaf-like bracts near the base of the flowering branches; flower buds obpyriform; petals linear-

oblong, swollen and concave at the base; fruit conoid or broadly ovoid, covered with dense felt-like pubescence, the individual carpels scale-like when immature, and projecting in thick blunt points directed toward the apex when mature, but sometimes suppressed so that the fruit is ovoid or subglobose in shape; seeds golden-brown or buff colored, obovoid to oblong, with a hard smooth testa devoid of a marginal groove or wing, enveloped in a thin membranous covering when fresh, and surrounded by a richly flavored, cream-colored or rose-tinted, edible pulp.

Type in the U. S. National Herbarium, No. 398834, collected near the city of Colima, western Mexico, July 1897, by Dr. Edward Palmer (No. 60).

Distribution: Colima and Acapulco, western Mexico, to El Salvador; cultivated for its edible fruit. Local names: Ilama, Hilama, Illamatzapotl (Mexico); Anona blanca (Salvador).

Annona diversifolia is a small tree with deep green foliage, and light-colored brownish-gray bark, longitudinally furrowed and set with numerous lenticels. The tender young leaves at first are reddish or copper-colored, somewhat like those of a mango in color, but at length turn green and have a parchment-like texture. They differ essentially from the leaves of the closely allied *Annona macroprophyllata* Donn. Smith in size and form and in the length of the petiole. Diversity in shape and size of the leaves is common to many species of Annonaceae, usually the smaller and relatively broader leaves being found near the base of the flowering branches, and larger and relatively narrower leaves following in succession; but in the present species this diversity is most pronounced. The possession of persistent leaf-like clasping bracts at the base of the petioles separates this species together with *A. macroprophyllata* from the rest of the Annonas thus far known, and places them in a section apart, which I have called Ilama.[8] These bracts are glabrous in the present species, while in *A. macroprophyllata* the bracts are ciliate on the margin. The smaller and relatively broader leaves at the base of the branches

[8] See Safford, W. E.: "The Genus Annona: the derivation of its name and its taxonomic subdivisions." Journ. Washington Acad. Sci., 1: 118–120. September, 1911.

are 5 to 6 cm. long and 3.8 to 4.8 cm. broad; the largest are 10 to 14 cm. long and 4 to 6 cm. broad, rounded or obtuse at the apex and usually acute or cuneate at the base, with petioles 12 to 16 mm. long. The basal amplexicaul bracts are 25 to 35 mm. in diameter; the floral peduncles, remarkably long for this genus, are 4 to 5 cm. long. The small ovate or triangular calyx divisions are ferrugineous-ciliate on the margins. The fresh petals (20 to 24 mm. long) are described by Dr. Palmer as "light reddish or chocolate colored within and mauve or purple on the outer surface, becoming snuff-colored with age." They differ from those of *Annona cherimola* and its close allies in opening to the base when mature.

The fruit may be described as having the form of an enormous artichoke with an axis of 13 to 15 cm. and a diameter of 12 to 13 cm. On the same tree specimens may be found with the salient points of the carpels quite pronounced while in others they are scarcely apparent. In comparing it with the fruit of the chirimoya (*Annona cherimola*), Mr. Letcher states that the flesh of the ilama is usually pink, sometimes deep rose-colored, the hard nutlike seeds are yellow or yellowish brown (fig. 4 a), and the peel or rind is scurfy and inclined to be covered with projecting points. The chirimoya, on the other hand, has white flesh; dark brown seeds with a thin testa easily cut with a knife and surrounded by a marginal ridge (fig. 4 b); and an almost smooth skin usually with a wart-like protuberance near the apex of each outlined areole.

Fig. 4; *a*, seed of *Annona diversifolia*, *b*, seed of *Annona cherimola*, natural size.

Seeds sent by Mr. Letcher from Acapulco and by Don Rafael Castillo from Salvador are exactly alike; they resemble pine-nuts rather than ordinary Annona seeds. They are 20 to 21 mm. long, 12 to 11 mm. broad, and 10 mm. thick, so that they have a broadly elliptical or oval cross-section. The basal hilum is more or less depressed and is devoid of the thickened caruncle which usually surrounds the hilum in other species of Annona and in the allied genus Rollinia.

Mr. Letcher describes the fruit as "quite delicious" and in a recent communication received through the State Department from Mr. Samuel E. Magill, American consul at Guadalajara, he refers to the "ilama of Colima" as having a richer flavor than the chirimoya, the species which has hitherto been considered the queen of the custard apples.

ETHNOLOGY.—*Definitions of two primitive social states.* O. F. Cook.

Primitive social systems are usually classified by standards borrowed from legal or political science, such as the different systems of inheritance of property or rank. Familiarity with two groups of primitive people, in West Africa and Central America, has suggested the possibility of a different system of sociological classification, based on facts that have a more fundamental relation to the development of civilization.

That a primitive society be matriarchal or patriarchal, or that it be governed by a priestly or a military caste, does not determine its possibilities of progress, for progressive peoples have shown many differences and have survived many changes in these respects. More important factors have been contributed by the external environment, but none of these can be considered indispensable. Capable peoples have developed in apparently unfavorable environments, until they were able to choose their own environments. The underlying question of civilization is to know what conditions are really favorable for the development of human talent.

The essentials of civilization, considered as characters of human races, are not transmitted from one generation to another by prenatal inheritance like the instinctive arts of animals. Human arts and social adjustments have to be acquired by postnatal inheritance, thro the medium of contacts with parents and elders during the years of childhood and youth. It is reasonable, therefore, to believe that any factors or conditions that tend to increase or diminish these contacts are of practical importance in the development of civilization.

Two types of social organization may be distinguished by reference to the contacts between parents and children. In the choripedic state the children of different families are kept apart from each other, and remain associated with the parents and older members of the family. In the sympedic state the children of a community are associated in groups with others of similar age. The choripedic state provides complete contacts with the parents, the sympedic state only partial and imperfect contacts.

In his most primitive condition man may be thought of as roaming thru the forests in simple family groups, as the anthropoid apes and some very backward savages still do. After settled agricultural habits are adopted and permanent food supplies assured it becomes possible for the original family group to expand into a community. The dwelling may expand with the family into a large communal house, or the community may live in a cluster of houses, constituting a village. Both of these conditions are found among the natives of Liberia. The Kroo people of the coast live in large communal houses that may shelter two or three score of people. The interior tribes, such as the Veys, Golahs and Pessahs, live in very small, closely clustered houses. The social condition of the children is the same in the two kinds of communities, both representing the sympedic state. Children of nearly the same age spend most of their time playing together or chattering about in little groups, much like the squads or gangs of street children with us.

The social organization of the Kekchis and other related tribes of eastern Guatemala is essentially different from that of the Africans. Although these tropical Indians are even more strictly agricultural than the natives of tropical Africa, they do not associate in communal dwellings or villages. Each family lives by itself, often quite remote from any other. The Kekchis and neighboring tribes were aptly described by Otis T. Mason as "poor relations of the Mayas." Though unusually primitive and unorganized, they are closely related in language and other respects to the tribes that were farthest advanced toward civilization at the time of the Spanish invasion.

When families live isolated on the land, as among the Kekchis, the children have full opportunities to learn all the facts and acquire all the skill that the parents may possess, and transmit these arts in turn to their descendants. Capable parents not only produce more capable children, but give them a more effective equipment for life. It is easy to understand that civilization develops under such conditions, by gradual accumulation of the experience and accidental discoveries of successive generations. Among the Africans, on the other hand, the premature socialization of the children interferes with progress toward civilization. Postnatal inheritance is restricted when contacts between the generations are inadequate. There are smaller chances that progress made by capable individuals will be preserved and transmitted to their descendants.

With this difference of social organization in mind, it becomes easier to understand the striking contrast noted by so many travellers, historians and ethnographers, between the natives of Africa and America. The general distribution and diversity of archaeological remains on the American continent afford evidences of a generally favorable condition for the development of civilization. In tropical Africa, on the other hand, civilization has not only failed to develop but many introduced civilizations have degenerated into barbarism. This is not because the Africans are inferior as individuals to the Indians, for they generally have both physical and mental superiority. But the Indians were able to make more progress because they retained the superior social organization of separate families instead of taking the false step of premature socialization. It is true that many tribes of Indians in different parts of the American continent went over to the communal, sympedic system, but it does not appear that such tribes made progress toward civilization, even as far as the Africans.

The sympedic condition is not confined, of course, to primitive peoples, but supervenes whenever the family organization is weakened by crowding people together in villages or cities, becoming most intensified among urban populations that have ceased to practice any of the agricultural arts. Village-dwelling agricultural or pastoral people may preserve effective contacts

between the parents and the children, for the families usually separate for several months of the year, to plant their crops or tend their herds.

Agriculture is to be considered as the basis of civilization, not only because it affords the physical support of civilized man, but because it represents the condition of existence necessary for the development of civilization. Farm life usually supplies both society and solitude, the prime essentials of intellectual progress. All of the highly civilized races seem to have developed their powers during a primitive agricultural stage, preparatory to more conspicuous exploits in other lines of activity, military, political, industrial or artistic. The highest developments of specialized arts are often attained after civilizations reach the urban stage, but urban conditions are finally destructive of civilization.

When people leave the land and become continuously occupied with urban pursuits constructive contacts between parents and children are at an end. The home may still supply food, lodging and clothes, but other parental responsibilities are disregarded or transferred to the school. The child really belongs to a group of school children of his own age, rather than to a family group. He spends all his active hours with the other children, thinks their thoughts, speaks their language, and sees the world entirely from their point of view. Under farm conditions the children share in all the activities of their parents, instead of being relegated to an artificial scholastic state, apart from the life of the community.

The school makes for progress when it serves to supplement the parental contacts with other opportunities of learning. Civilization is a synthetic process, as some ethnologists have pointed out, but herding young children together does not advance civilization. Compulsory instruction of parents in the interest of home rearing of children would be a much wiser measure than compulsory attendance at schools. The school becomes an agent of disorganization when it weakens the family relations and gives the child less than he might have obtained from his parents. The juvenile savagery now recognized as a regular feature of our city populations is not a normal state of the children of civilized races,

as some educators have inferred, but is a result of the sympedic state, the premature association of the children with each other, and the lessening of contacts with parents and elders.

EVOLUTION.—*The story of evolution as revealed by a scolytid beetle.* ANDREW D. HOPKINS.

If the principle of evolution has the broad application we believe it to have, one should find in any individual form of life, as for example, a scolytid beetle, some evidences of its origin, some records of the more important events and progressive changes in its line of descent and of its near and remote relationship to other forms.

A review of this evidence and the facts made available by the living beetle shows that its body is composed of organic elements, that it is rendered active by the element of life, and that in this and other evidences of its relationship to organic and inorganic nature there is proof of universal unity. In its development from an organic unit or mother cell it has furnished some of the evidences of its line of descent from a simple protozoid source to a complex metazoid form, from a simple vermiform type to a complex larval-form type, and thence thru radical changes and transformations to the adult, so that the development of the individual indicates the processes in the development and evolution of the race. It suggests that, since all organisms develop from a primitive cell, all existing forms of life have evolved from a common unicellular base. It also indicates that each major division of the various classes of animals and plants have descended thru more or less direct and independent lines of divergence from a primitive mass rather than from pairs of individuals.

This scolytid beetle represents, in its structural characters, the order Coleoptera, suborder Rhynchophora, superfamily Scolytoidae, family Scolytidae, genus Scolytus, and species scolytus. Thus, it belongs to a great coördinate system, and in its combination of elements of structure and vital and social activities it manifests the fundamental processes, principles, and laws under which it is enabled to exist as a unit of this system.

Therefore, we do find in the individual beetle much of the story

of evolution, both in a restricted and broad application to organic and inorganic nature. In other words, we find the story revealed by existing evidences and facts rather than by those of the past.

The dominant elements of structure and habit which serve to distinguish the individual beetle from all other forms are significant. In a review of the morphological evidence, we find that in addition to the fundamental cellular structure common to all forms of life, it is distinguished from the protozoans by characters common to the metazoans, from the vertebrates by characters common to the invertebrates, from other invertebrates by characters common to anthropods, from the other anthropods by characters common to the hexapods, from other hexapods by characters common to the Coleoptera, from other Coleoptera by characters common to the Rhynchophora, and so on, down to the characters of the family, genus, and species, and finally, to those peculiar to the individual. But this is only an outline of the chapters and volumes of the story of evolution as revealed by the morphological elements alone. The story is continued and verified in the physiological evidence revealed by the characteristic activities common to the various groups it represents, such as those found in the methods and processes of acquirement, ingestion, digestion, and assimilation of food, the processes of development and reproduction, the struggle for existence, and finally the influences of heredity and environment on the character of the individual, the species, and the race.

Thus, the individual in its ontogeny and its morphological and physiological elements, reveals a long interesting story—a story with many complex and poorly defined features which are subject to a wide range of interpretation and theories as to the fundamental and minor features of the processes of evolution.

The more plausible theories that have been advanced are not entirely satisfactory because in the final analysis there is so much that is yet to be explained. As applied to biology, the principle of natural selection is the most satisfactory but natural selection is only one of the many and complex factors in the process of evolution as applied, in its broadest sense, to matter and consciousness.

A study of the scolytid beetles to determine their relation to forest trees and other plants, to each other, and to nature in general, has suggested some lines of thought and interpretation which have led to the consideration of some of the problems of evolution from a viewpoint somewhat to the reverse of the usual.

It seems to me that there is a higher, more powerful, more dominating, and universal principle of evolution than has yet been recognized; a principle which is manifested to a greater or ess extent in all progressive changes in inorganic and organic forms and activities.

That there is a universal law of progressive adjustment towards an equilibrium between opposing elements and manifestations in matter and consciousness and a dominant law of progressive and parallel development and modification of structural and physical elements towards ultimate and definite forms, and that these laws are fundamental in all evolutionary processes.

That evolution from a primitive source has been by the process of accession, combination, and progressive modifications of structural and physical elements rather than by that of reduction and loss of elements. That a specific element once acquired is never entirely lost.

That among organisms natural selection and heredity, Mendel's law and the mutations of DeVries exert their greatest influence on the minor characters and characteristics of the individual, the variety, and the local section of the species, rather than on the characters and characteristics of the species as a whole, the genus, or the major division of the greater systems of so-called natural affinities.

That the independent origin and development of the same kinds of animals and plants in different parts of the world under continued similar environments is no more remarkable or improbable than the independent origin and development of the same kind of crystal, elemental metal, or chemical element.

That the development of the same kind of appendages in different classes and orders of animals could not have been due to phylogenetic descent from a common ancestor with similar appendages unless we admit special creation. Therefore, the origin

of the same or similar elements of structure and activity, in widely separated classes and orders, must have been independent. It is also evident that the progressive modification of these elements from the simple to the complex must have been along parallel lines in response to the momentum of a dominant tendency towards a common plan under the strain of similar requirements in the struggle for individual and racial existence and supremacy.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

METEOROLOGY.—*Waves of pressure in the atmosphere recorded by an interferometer barograph.* ALBERT C. CREHORE and GEORGE O. SQUIRE. Bulletin of the Mount Weather Observatory, 4: 115–118. 1911.

In addition to the large changes in atmospheric pressure that are indicated by every barometer, there are numerous minute and rapid fluctuations that are neither recorded nor shown by any ordinary barometer, whether mercurial or aneroid.

Several methods have been developed, however, for showing and recording these minute and often nearly rhythmical changes in atmospheric pressure; but the one under review probably is the most exact and delicate of all.

It consists essentially of a vertical pile of aneroid cells capped by a silvered flat that, with change of pressure, correspondingly changes its distance from a fixed half-silvered surface.

When properly supplied with monochromatic light the resulting interference rings are almost constantly in motion, first in one direction and then the other, in quick and delicate response to every pressure change.

By the aid of a slit across the interference rings, a camera, and a uniformly moving film, the pressure changes can be permanently recorded: —the negatives and the prints they yield looking like ribbons of watered silk. W. J. HUMPHREYS.

TERRESTRIAL MAGNETISM.—*Distribution of the magnetic declination in the United States for January 1, 1910.* R. L. FARIS, Coast and Geodetic Survey. Special Publication No. 9, pp. 14, with 1 map.

This publication just issued by the Coast and Geodetic Survey contains secular change tables of the magnetic declination and a magnetic declination chart of the United States for the year 1910. On the chart are also shown the lines of equal annual change of the magnetic declina-

tion in 1910. Since the publication of the 1905 declination chart so many additional data have been accumulated and the secular change has undergone such material modification that a new chart was needed. January 1, 1910, was chosen for the date of the chart in order that the reduction of the declination data to a common epoch, might be based upon actual observations of the annual change. Special attention was given in 1909 and 1910 to obtaining observational data of the secular change.

The isogonic lines are shown on the chart for each degree of magnetic declination. The distribution of the lines of equal change shown on the chart differs materially from that of the lines on the 1905 chart (which the present chart now supersedes), the most marked characteristic being a crowding of the lines toward the line of no annual change. West declination is increasing much more rapidly in the North Atlantic states than was supposed in 1905, the annual change now being about six minutes in the New England states. On the Pacific coast east declination is increasing more rapidly than it was in 1905, but apparently the region of maximum annual change is now some distance inland.

Under the present conditions of rapidly varying annual change it is not possible to predict accurately what these changes will be even for a few years in advance.

In connection with the present large annual change in New England it may be noted that west declination is increasing about seven minutes a year in Bermuda and about nine minutes per year at Vieques Island, Porto Rico. R. L. F.

PHYSICAL CHEMISTRY.—*Die Untersuchung von Silikaten.* ARTHUR L. DAY. Z. Elektrochem., **17**: 609. 1911.

An address given at the annual convocation of the Bunsen Gesellschaft, held at Kiel, Germany, reviewing some of the more interesting phases in the laboratory investigation of silicates compared with some of the more familiar fields of physico-chemical research.

MINERALOGY.—*The melting points of minerals in the light of recent investigations on the gas thermometer.* ARTHUR L. DAY and ROBERT B. SOSMAN, Geophysical Laboratory. American Journal of Science (4) **31**: 341. 1911.

Before the completion of the gas thermometer measurements to 1550° C. at the Geophysical Laboratory, the temperature measurements made in this laboratory with thermo-elements had been interpreted in the

usual way, by extrapolating the curve of temperature and thermal electromotive force. These results now require to be corrected by the amount of the difference between the old temperature scale and the new, which makes it necessary to recalculate the existing temperature data of this laboratory in terms of the new gas scale. This paper presents a summary of the values resulting from this recalculation.

Some of the European students of silicate solutions have encountered difficulties in the determination of mineral melting-points which have led to the belief that most or perhaps all minerals do not melt at a determinable "point," but rather that the phenomena of melting extend through a considerable temperature interval. Experimental evidence is here offered, in the case of two of the typical minerals in question, that this uncertainty was merely the result of the experimental method employed. This is a matter of some importance, because the above conclusion, if true, would necessitate a new system of definitions for melting silicates. A. L. D. and R. B. S.

GEOLOGY.—*Geologic atlas of the United States, Folio No. 174, Johnstown, Pa.* W. C. PHALEN. U. S. Geological Survey, Pp. 15, with maps, sections, and views. 1911. *Mineral resources of Johnstown, Pa., and vicinity.* W. C. PHALEN and LAWRENCE MARTIN. Bulletin U. S. Geological Survey No. 477. Pp. 142, with maps, sections, and views. 1911.

The Johnstown quadrangle, embracing 228 square miles, is situated in west-central Pennsylvania near the eastern escarpment of the Appalachian Plateau. The rocks are entirely sedimentary and range in age from Devonian (Catskill formation) to the Conemaugh formation of the Pennsylvanian series of the Carboniferous. They have a thickness of about 3200 feet and are bent into northeast-southwest folds. The structure as worked out differs in some particulars, especially near Johnstown, from the results obtained by the Second Geological Survey of Pennsylvania.

The mineral resources include coal, clay, shales, limestone, and cement materials, building stone, paving block, concrete materials, glass sand, and iron ore. Numerous analyses of these commodities are given with the results of steam, coking, briquetting, cupola, producer-gas, and float and sink tests of the coals.

At least five coals, confined to a vertical interval in the Allegheny formation, ranging from 150 to 200 feet, are locally workable.

W. C. P.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE WASHINGTON ACADEMY OF SCIENCES

The 75th meeting, the 14th annual meeting, of the Washington Academy of Sciences was held at the Cosmos Club, 8 p.m. January 20, 1912, with President F. W. Clarke in the chair, and forty-two members present. The minutes of the previous annual meeting, and abstracts from the minutes of all subsequent meetings were read and approved. The reports of the officers and Auditing Committee were received.

The following were elected resident members:

Eugene Thomas Allen	J. A. Le Clerc
William Bowie	William Gerry Morgan
Charles John Brand	John B. Nichols
Edgar Brown	Perley Gilman Nutting
A. Hugh Bryan	Carl S. Scofield
Edgar Buckingham	Homer Le Roy Shantz
Guy N. Collins	Cornelius Lott Shear
Charles Albert Davis	Philip S. Smith
Edgar Curtis Franklin	George Owen Squier
Albert W. C. Herre	Paul C. Standley
William Francis Hillebrand	William Alton Taylor

The report on the ballot by mail for officers for 1912 showed the following elections: President, F. V. COVILLE. Non-resident Vice-Presidents: T. C. CHAMBERLAIN, DAVID STARR JORDAN. Corresponding Secretary: ARTHUR L. DAY. Recording Secretary: W. J. HUMPHREYS. Treasurer: ALFRED H. BROOKS. Managers, Class of 1915: J. S. DILLER, DAVID T. DAY.

The following were elected resident vice-presidents as nominated by the affiliated societies: Anthropological Society: F. W. Hodge. Archeological: Mitchell Carroll. Biological: E. W. Nelson. Botanical: W. R. Maxon. Chemical: J. A. Le Clerc. Engineers: George W. Littlehales. Entomological: L. O. Howard. Geographic: Henry Gannett. Geological: David White. Historical: James Dudley Morgan. Medical: John B. Nichols.

It was moved by Dr. Briggs and seconded by Dr. Howard, that a vote of thanks be extended to the retiring Corresponding Secretary, Dr. Frank Baker, for his long and valuable services to the Academy. This was unanimously carried by a rising vote. Dr. Baker made an appreciative reply.

A unanimous vote of thanks was also extended to the retiring President, Dr. F. W. Clarke.

The newly elected President, Mr. F. V. Coville, then took the chair, and after a few happy remarks, introduced the speaker of the evening, Dr. F. W. CLARKE, who traced the origin and history of the Washington Academy of Sciences, and dwelt especially on the need for and value of the Academy's newly established Journal.

W. J. HUMPHREYS, *Recording Secretary.*

ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 455th regular meeting of the Soc'ety was held October 24, in the New National Museum. The first paper read was by Mr. J. MOONEY, on *Indian Survivals in the Carolinas.* He gave a brief account of his summer's work with the eastern Cherokee on their reservation in the mountains of western North Carolina, and with some mixed-blood survivors, locally known as Croatan Indians, in the eastern part of the state. The east Cherokee numbering about 2000, are descendants of those who fled to the mountains when the body of the tribe was removed to the Indian Territory in 1838. They still retain most of their aboriginal customs and beliefs, together with their language, although the larger tribal ceremonies are nearly obsolete.

The Croatans, so-called from an attempt to identify them with Raleigh's lost colony of 1585, are centered chiefly in Robeson County, to the number of about 8000 according to the last census, with bands in adjoining counties and in South Carolina. They appear to be descendants of the original native tribes of the same region, largely mixed with alien blood, the Indian blood still predominative, altho they have completely lost all knowledge of Indian customs, language or tribal names. They are intelligent and prosperous people, farmers and small tradesmen, fully up to the level of their white neighbors. They have official recognition from the state as Indians, with a separate school appropriation and support of a small paper called the *Indian Observer* devoted to their interests.

Mr. HODGE gave an exhibition and talk on the speech and civilization of the seventeenth and eighteenth centuries in New Mexico. Dr. P. RADIN spoke on *Some Archeological problems of the Winnebagoes.* Dr. Hrdlička suggested that the fact that physical anthropology found of the skulls in the Wisconsin mounds should be taken into consideration by the speaker.

The 456th regular meeting of the Society was held in the New National Museum November 14. The speaker of the evening was, Mr. W J McGEE on *Conditions limiting the growth of population in United States.* His talk was an elaboration of his paper in Science. (Oct. 6, 1911, pp. 428–435.)

The 457th regular meeting of the Society was held in the New National Museum January 16. Dr. J. W. FEWKES lectured on the *Western neighbors of the Prehistoric Pueblos,* illustrating his remarks with lantern slides. The early Spanish discoverers designated the habitations of the sedentary Indians of the Southwest by several names as pueblos, casas grandes, rancherias, and trincheras, the word pueblo being espe-

cially assigned to a compact several storied community house of terraced form represented most abundantly along the Rio Grande. The large houses on the Gila river they called casas grandes and they gave the name rancherias to fragile walled dwellings made of brush and clay supported by logs. Defensive walls were sometimes called trincheras. Each of these names indicates distinct architectural types altho they were not used with accuracy. In late years it happens that all ruined buildings of the Southwest, especially those independent of cliffs are called pueblo ruins, the culture of the people that once inhabited them being designated, the pueblo culture. It is well to preserve the term pueblo for the crowded terraced many storied buildings to which it was originally applied, and when this is done the distribution of the pueblo type in our Southwest is considerably restricted. The stone ruins ascribed to the ancient sedentary inhabitants of Arizona from the upper Verde river west to the Colorado are not true pueblos. In this region there predominated massive stone forts of magnitude and fragile walled houses with stone foundations; a duality everywhere evident. The indications are that both kinds of buildings were constructed and used simultaneously by the same people. The forts being situated on inaccessible hill tops were asylums for safety, and more perishable buildings on the river terraces were habitations near aboriginal farms. The great number of these forts on the western border of the pueblo region implies a great necessity for defense along the whole western border of Arizona and Sonora in Mexico.

Dr. Fewkes gave a brief account of the different forts and terrace dwellings on the upper Gila and its tributaries, Sycamore, and Granite creeks, the Chino and Williamson valleys and Walnut creek to the mouth of the Santa Maria and other tributaries of the Colorado, all examples cited substantially agreeing in the duality of architectural type and the absence of true pueblo structure.

The simple construction of the forts and the rude character of the masonry made of undressed stone, without mortar, was referred to. Views of the remains of dwellings or rancherias on the river terraces were shown and commented upon. Terrace sites indicated by rectangular and circular rows of stones and low mounds occur all along the Chino and Walnut valleys to Aztec Pass. These show no evidences of kivas or sacred rooms, or many storied dwellings. The pottery found near them is rude, sometimes decorated, the pictography is characteristic, the people made extensive irrigation ditches.

The most important forts mentioned were those on the upper Verde near del Chino, and on the limestone ridge west of Jerome Junction. Two important forts (one is situated near the mouth of Walnut creek and the other at Aztec Pass, the latter being the "Pueblo" first described by Wheeler) were referred to. Maps of the Walnut creek region are defective, the most prominent elevation, Mount Hope, being wrongly located on some of the latest maps issued by the Land Office. Big Burro and other streams west of Aztec Pass have forts overlooking enormous canyons of great scenic interest.

The geographical distribution of the forts and trincheras in western Arizona corresponds in a general way with the northern extension of the Yuma stock according to Major Powell's linguistic map. The country west of the Verde valley in which the ruins occur was peopled by Yavapai, Hualapai, Havasupai, and other Indians called by Cortez, Apaches. The Havasupai who now live in the depths of the Cataract Canyon, and the Hualapai are said to have legends that their ancestors constructed some of the buildings considered. The Hopi Indians dwelling in the pueblo Oraibi claim that certain of their clans came from the west and are of Yuma stock. The question of the kinship of the ancient builders is of interest to the physical anthropologist as well as to the linguist and student of culture history. As the Indians of Yuma stock formerly extended to the Pacific the possible kinship of the western neighbors of the pueblos to tribes of southern California is significant.

Dr. HRDLIČKA in discussion said that the results of the direct study of man himself in the region west of the pueblos agree in a large part with the conclusions arrived at by Dr. Fewkes, but in part they also differ. It is quite possible that the region about and west to southwest of the Aztec Pass was once occupied by either the Mohave or Yuma. The people against whom they had to defend themselves, however, were more probably the Apaches. The Walapai and Supai who today speak the Mohave language, are physically Apache and the same is true of the Yavapai. As the Apache type is a very distinct one, this conclusion is quite definite. Both tribes contain, of course, some Mohave and probably also Pueblo admixture.

Dr. HRDLIČKA showed a series of views of special Supai and Walapai huts which are related to those of the Apache but are totally distinct from those of the Mohave and Yuma, and numerous types of men and women from the several tribes, showing great resemblance between the Walapai and Supai and the Apache, while the Mohave resemble much more closely the pueblos.

Mr. GEORGE STETSON then spoke on the code of Hammurabi. His remarks showed how humanitarian the code was, and what advance it was on Roman law in several respects tho antedating the latter by centuries. The speaker also demonstrated how the laws of various states of the union and certain foreign nations might well be advantageously amended on the lines of the code under discussion.

TRUMAN MICHELSON, *Secretary.*

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 702nd meeting was held on January 13, 1912. Two papers were read. *Krümmel's Handbuch der Ozeanography, Vol. II:* R. A. HARRIS, of the Coast and Geodetic Survey.

The speaker gave a condensed review beginning with the treatment of ocean waves. The errors concerning the energy of waves were pointed out. Then seiches, tides, ocean currents, vertical circulation and ocean streams were discussed. This extensive and valuable treatise on oceanography contains a lot of information not elsewhere brought together.

The determination of the pole distance of a very small magnet: J. M. MILLER, of the Bureau of Standards.

If two circular coils, which are linear single turns, are adjusted so that they are coplanar and concentric, and if two currents are sent in opposite sense around the coils, the two magnetic fields will annul each other at the common center if the ratio of the two currents is equal to the ratio of the radii of the two coils. This gives a method of comparing the radii of coils experimentally. In such a comparison the neutralization of the two fields is usually indicated by a short magnetic needle which is suspended at the common center of the two coils and lies in their common plane.

On account of the finite length of the magnet an error is introduced into the comparison equal to $\frac{3}{4} K$ where K is a known function of the pole distance of the magnet and the radii of the coils. If, however, the needle is rotated by torsion or otherwise, out of the plane of the coils, the ratio of the neutralizing currents is changed by a factor $\frac{1}{4}^5 K \sin^2\alpha$ where α is the angle through which the magnet has been rotated. Hence by measuring the angle α and also the change in the ratio of the neutralizing currents, K can be determined and from this, the pole distance of the magnetic needle can be calculated.

A piece of steel of only 2.314 mm. length was used as the magnetic needle and the pole distance for this very short magnet was determined to an accuracy of about three per cent. The resulting value for the pole distance was 1.956 mm.

Kohlrausch's modulus which is the ratio of the pole distance to the total length of the magnet is, therefore, equal to 0.845. Thus in the case of this extremely short magnet, the poles are situated approximately one-twelfth of the total length from the ends, which agree closely with the results obtained by Kohlrausch and others for long magnets.

R. L. FARIS, *Secretary.*

THE BOTANICAL SOCIETY OF WASHINGTON

The 78th meeting was held February 6, 1912. Mr. W. W. Ashe, of the Forest Service, and Dr. H. W. Wollenweber, of the Bureau of Plant Industry, were elected to membership. The following papers were read:

Conditions favorable to Septoria lycopersici Speg.: J. B. S. NORTON.

The author gave a brief résumé of a series of observations on the development of Septoria under different conditions influencing growth.

The relation of soil acidity to plant societies: A. W. SAMPSON.

The plant ecologist has long recognized the fact that different soils support different plants. The significance of characteristic plant societies and communities, with respect to the acidity or alkalinity of the soil and its effect on the growth of cultivated plants, was strikingly brought to my attention in a study of the revegetation of depleted grazing lands on the Wallowa National Forest in northeastern Oregon.

It was found that the soil preference of some of the most promising

cultivated species, such as *Trifolium repens*, for example, like a great many other Leguminosae, was extremely sensitive to acid or sour soils. Many such plants can exist only for a couple of seasons in a soil requiring more than 6000 pounds of lime per acre foot, that is, to a depth of one foot. On the other hand, some forage species, notably *Agrostis alba*, as evinced by the luxuriant growth made, prefer sour soils. Thus, in a judicious reseeding of the native depleted grazing lands, a study of the native plant societies, as indicators of acid alkalinity or neutrality of the soil, is imperative.

In general, strongly acid habitats are characterized by a superabundant supply of moisture coupled with poor drainage. Locally, such lands usually support dense stands of vegetation, such as Carex, which often produce a matted surface and an entanglement of long root stalks which bind the soil firmly.

When this study was first undertaken, it was presumed that the latter soils—those with an intricate mass of interwoven roots and having an air dry weight of 15 pounds per cubic foot, were the more acid. Later, however, it was found that the sour soils are those of the well-drained lands which support the mountain bunchgrass (*Festuca viridula*) society. The soils upon which this society occurs vary in lime requirements for neutrality from 5000 pounds as a minimum to 41,000 pounds as a maximum. Such habitats are found to be acid to a depth of about five feet. The greatest lime requirements for neutrality occur in the superficial layer.

The acid endurance and requirements of the various local conspicuous plant societies follows: They are arranged in accordance with the degree of acidity of the substratum.

(1) *Festuca viridula* society, (2) Carex society, (3) Alnus-Salix society, (4) Veratrum-Rudbeckia-Mertensia-Valeriana society, (5) Phleum-Elephantella-Dodocatheon society, (6) Vaccinium-Phyllodoce society, (7) Deschampsia-Juncoides society, (8) Pinus-Calamagrostis society, (9) Pinus-Abies-Polemonium society, (10) Panicularia-Cinna society.

The mountain bunchgrass (*Festuca viridula*) society, as stated, has the most acid soil. It occurs throughout the extensive well-drained meadows, and bald buttes of the Hudsonian zone on the characteristic basaltic clay loam soils.

While the genera that make up these associations are mainly confined to sour soils, some species seem to show no particular preference for acid lands, or at least they occur abundantly alike on sour, neutral, and alkaline soils. The most important genera that inhabit the calcareous rock formations are: Pteridium, Aquilegia, Achillea, Pentstemon, Lupinus, Erigeron, Agropyron, Elymus, Sitanion, Stipa, Berberis, Artemisia, and Populus. Of these it is definitely known that Pteridium, Lupinus, Stipa, and Populus occur also on somewhat sour soils.

Ever since the day of Unger and Thurmann, there has been considerable difference in opinion regarding the relationship between soil acidity and vegetation. A grouping together of plants into societies, doubt-

less depends both upon the physical and chemical condition of the substratum. In the regions studied, however, the physical texture and the water content seem to be of secondary importance.

Notes of travel in Central America: A. S. HITCHCOCK.

Having visited the Canal Zone as members of the Smithsonian Biological Survey, Mr. Hitchcock and his son, made a two months' side trip to Central America. Collections were made in Costa Rica at Port Limón, San José and Puntarenas, in Nicaragua at San Juan del Sur, Corinto, Masaya and Jinotepe, in Honduras at Amapala, in Salvador at La Unión, Acajutla, Santa Ana and San Salvador, in Guatemala at Guatemala City, Volcano Agua, and Port Barrios.

The botanical results of the trip were very satisfactory, consisting of 760 numbers of grasses, and many photographs illustrating the habit of growth of the larger species. The collections in the National Herbarium from Central America, with the exception of Costa Rica, were meagre, especially from Nicaragua and Salvador. There appear to be several new species in the collections and also many species that have been rare in herbaria but have proven to be abundant in this region. Among the rare species may be mentioned: *Bouteloua pringlei*, from Salvador, only known heretofore from Guerrero, Mexico; *B. americana*, known only from the West Indies; *B. disticha*, common on the Pacific slope, of Central America; *Uniola pittieri*, common on sandy beaches from Puntarenas to Panama; *Jouvea straminea*, abundant at Corinto and Acajutla. In a recent monograph upon the genus Panicum in North America all our knowledge of this group was brought together but many species of the southern portion of this region were very imperfectly known. In the subdivision of the genus, known as Parviglumia, many collections during the past season from various localities have shown certain species such as *Panicum virgultorum* and *P. parviglume* to be widely distributed and not uncommon. The genus Lasiacis, allied to Panicum of which it was formerly considered a section, has presented many difficulties because herbarium specimens have shown only the panicles and a few leaves. The plants however are large, usually much branched and woody. Notes and photographs taken from the living specimens show that there are good characters based upon habit, method of branching and the appearance of the young shoots. The species of this group are numerous and well-marked and it is hoped that the distinctive characters observed in the field may be coordinated with those observed in herbarium specimens and thus lead to a satisfactory revision of the genus. One outlying member, *L. procerrima* (*Panicum procerrimum*), known only from the type collection in Costa Rica, was found to be wide spread, though not abundant, from southern Mexico to Panama. It is remarkable that this species, growing to the height of 5 to 8 feet, and having a panicle as much as two feet broad, should have been so little-known. These collections made in Panama and Central America together with those made the preceding year in Mexico give a fair knowledge of the grass flora of these regions.

W. W. STOCKBERGER, *Corresponding Secretary.*